MULTIMEDIA UNIVERSITY

STUDENT ID NO

MULTIMEDIA UNIVERSITY

FINAL EXAMINATION

TRIMESTER 2, 2022/2023 (TERM ID 2220)

DCA5231 – COMPUTER ARCHITECTURE

(DIT)

10 JULY 2023
2.30 p.m. – 4.30 p.m.
(2 Hours)

INSTRUCTIONS TO STUDENT

1. This question paper consists of **3** pages (excluding cover page).
2. Answer **ALL** questions.
3. Write your answers in the answer booklet provided.

Structured Questions, 4 Questions (Total: 40 Marks)
Instruction: *Answer **ALL** the questions in the Answer Booklet provided.*

QUESTION 1 (10 Marks)

Assume that currently the Program Counter (PC) holds 781H. Execute the **FIVE (5)** instructions starting from 781 and show the calculations and contents of the registers (PC, AC and IR), as well as any changes made to the memory at the end of each instruction. The original memory content, relevant instructions with their meanings are shown in **Figure 1**.

[10 Marks]

Address	Content
781	1862
782	5861
783	6860
784	5863
785	2860
...	...
860	2DD7
861	C1F4
862	3B5A
863	1E28
...	...

Memory content

Instruction	Meaning
0001	Load AC from memory
0010	Store AC to memory
0101	Add to AC from memory
0110	Subtract memory from AC

Partial list of opcodes

Figure 1: Memory content and partial list of opcodes

Continued...

QUESTION 2 (10 Marks)

a) Use an 9-bit binary representation (2's complement) to show how $83_{10} - 126_{10}$ is calculated. Verify the result. [2 Marks]

b) Convert $6D9F.A87_{16}$ to its octal equivalent. All the necessary steps to obtain the answers must be shown. [2 Marks]

c) Given the following expression,

$$\mathbf{Y = [((M - C) * K) / S] * [J / B + P]}$$

Write the following machine instructions:

- Zero-address [2 Marks]
- One-address [2 Marks]
- Two-address [2 Marks]

QUESTION 3 (10 Marks)

A computer system has a memory architecture made up of main memory of 15GB and cache of 16384KB. In order to perform an efficient mapping function, the main memory is arranged in blocks of 1024 bytes.

Draw the address structures for different mapping functions as stated below. Indicate the fields and the number of bits required for each field.

i. Direct Mapping [3.5 Marks]
ii. Eight-Way Set Associative Mapping [3.5 Marks]
iii. Associative Mapping [3 Marks]

Continued...

QUESTION 4 (10 Marks)

a) Briefly explain any **TWO (2)** characteristics of bus system. [2 Marks]

b) Briefly explain the **THREE (3)** I/O techniques. [3 Marks]

c) Given SEVEN (7) instructions where each instruction has SEVEN (7) stages (FI, DI, CO, FO, EX, MEM and WO) with delays of 6, 4, 3, 8, 4, 5 and 6 seconds for each stage respectively.

Calculate the **total processing time**, **speedup** and **throughput** for the implementation of pipelining and non-pipelining. [5 Marks]
[Note: Please write the formula that is appropriate to use]

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